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REVIEW

From Hesitation to Participation: Examining Behavioural Barriers to Engage Customers in Flexibility Markets

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Abstract

Purpose of the Review The increasing penetration of distributed energy sources into the electricity system requires greater customer engagement in providing new flexibility services. This article reviews the main behavioural barriers and existing gaps related to customer engagement in emerging flexibility markets.

Recent Findings Greater attention should be put on collecting more experimental evidence from the field to finalise the development of appropriate engagement strategies that can avoid unexpected customer reactions, especially when different incentives and information are provided.

Summary Based on an extensive review of the literature, we identified three overarching groups of behavioural barriers to customer engagement in flexibility markets, namely: (1) lack of awareness, (2) lack of skills to process information, and (3) inertia. Furthermore, there is still no consensus on the effectiveness of incentivisation mechanisms and information strategies that can enhance customer engagement.

Keywords Customer Engagement · Flexibility Markets · Demand Response · Behavioural Economics · Barriers · Energy Transition

Introduction

The integration of distributed energy sources in the electricity system is leading to an increased demand for flexibility services, while the development of digital technologies also enables customers to offer these services. In this context, growing attention is directed toward the establishment of dedicated electricity markets where customers can trade "flexibility" [1]. Despite the well-known benefits that flexibility services can bring to the electricity system, numerous enabling factors are still lacking to fully tap the potential derived from demand response [2]. In particular, a customer-centric approach is necessary to enhance customer engagement, optimise the use of smart grid technologies, increase the deployment of renewable energies, and support network flexibility [3, 4].

Considering the pivotal role customers could play in delivering flexibility services, their greater participation in the emerging flexibility markets is highly desirable. However, models proposed by neoclassical economics fail to accurately predict customer behaviour (e.g., rational optimisation of personal welfare). On the other hand, behavioural economics adapts neoclassical models of human decision-making by allowing for deviations from rationality [5]. Identifying the primary drivers of customer behaviour and recognising potential barriers that impede the engagement process are essential steps in formulating effective strategies to enhance customer participation in flexibility markets.

This literature review uncovers the key behavioural barriers that could impede customer engagement in flexibility markets, particularly focusing on small consumers (e.g., households).[1] Due to the lack of extensive literature on consumer behaviour in flexibility markets, this literature review

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[1] In the following the terms "consumer" and "customer" are used interchangeably, with the former emphasising aspects associated with the physical usage of energy, while the latter is more related to the economic implications of energy consumption [6].

gleans insights from the application of behavioural economics in other energy-related domains. This paper is organised as follows. Firstly, we provide a high-level description of energy consumers behaviour in order to present a basic overview on the main distinctive features of consumers' decision-making process. Secondly, we review the main behavioural barriers we encountered in our review that can hinder the engagement process in flexibility markets. Then, a third section is dedicated to presenting unresolved issues for which there is no academic consensus regarding our understanding of energy consumer behaviour. The paper concludes with final remarks and reflections on the topic's relevance for policymakers and market actors.

Understanding Consumer Behaviour

Customer participation in flexibility markets may sometimes clash with their existing behaviours (e.g., habits) or a lack of engagement and knowledge on the subject. Indeed, consumers do not always optimise their economic benefits; on the contrary, numerous variables can impact the decision-making process. This section aims to provide an introductory overview of the consumer decision-making framework.

Individuals as consumers are often viewed as entities striving to maximise utility, bounded by their search efforts, limited insights, mobility, and financial resources [7]. Customers should not be viewed as uniform or static; rather, their attributes can vary across individuals and evolve. This indicates that strategies for engaging with customers must adapt based on these varying characteristics and life changes. While each customer is unique, for the sake of analysis and operational efficiency, it is feasible to categorise customers into distinct groups or types [8]. This discussion primarily targets smaller consumers like households (and small to medium-sized enterprises), given that larger entities usually devote more resources to professionally target energy markets and possess more market experience, making their decision-making processes more analytical and focused on business outcomes [9].

The study of energy consumption behaviours has been a robust field of research since the 1980s, exploring key drivers behind energy use, especially in residential contexts. Research has been bifurcated into two main areas: one investigating pro-environmental actions such as sustainable consumption and conservation, and the other analysing consumer reactions to the deregulation of the energy sector, including changes in energy suppliers and participation in demand response programs. Recent studies have extended to include behavioural tendencies towards participating in flexibility markets, with insights drawn from various EU-funded projects like CoordiNet, Platone or OneNet [8, 10, 11]. Despite the specific focus of these studies, their findings on consumer behaviour offer broad applicability [12].

From a neoclassical microeconomic perspective, consumer decisions are presumed rational, aimed at maximising personal utility within their resource constraints. This view holds that consumer preferences are stable and seek satisfaction through market exchanges, with consumer choices revealing their underlying preferences. For example, the decision to adopt or reject energy-efficient technologies is theoretically based on a rational evaluation of costs versus benefits. Deviations from this rationale are often attributed to market failures such as information asymmetry or transaction costs, leading consumers away from optimal choices. Thus, policy interventions typically do not target irrational consumer behaviours. However, assuming consumers are capable of resolving complex optimisation problems is impractical; real-life decisions are complex, and consumers generally do not have the necessary expertise or time to undertake such detailed analyses [13]. Traditional microeconomic theory falls short of fully capturing consumer energy behaviour, as evidenced by extensive research indicating deviations from purely cost-minimising behaviours [14].

Consumers are more accurately described as agents with cognitive limitations or, as Herbert A. Simon suggested in 1955, as boundedly rational agents who seek satisfactory solutions rather than optimising their utility functions [15, 16]. In fact, human rationality is constrained by computational ability and time constraints [17]. To navigate these limitations, consumers often resort to mental shortcuts and intuitions, which can introduce cognitive biases into decision-making processes [18]. Among different "schools of thought", some of these systematic deviations from optimum behaviour have been explained by loss aversion, as outlined by Kahneman and Tversky (1979) in their prospect theory, which is particularly relevant in predicting consumer decisions under uncertainty, a common element in energy-related decisions [19]. This theory highlights that losses and gains are valued differently by individuals, with losses typically having a greater impact than an equivalent gain. This asymmetric valuation can influence consumer perceptions in flexibility markets, affecting decisions based on potential losses in autonomy, comfort, or privacy [20].

Moreover, cognitive limitations render consumer preferences volatile and susceptible to the influence of psychological and sociological factors. Understanding also factors such as motivations, attitudes, and values is therefore crucial for devising effective engagement strategies. However, having a clear understanding in this regard is not easy. In fact, the literature on customer engagement varies widely due to the diverse contexts and subjects involved, often emphasising either psychological or sociological influences.

Psychological factors include attitudes towards environmental issues, a sense of responsibility, and the perceived impact of one's actions [18]. For instance, consumers indifferent to environmental impacts are less likely to participate in green initiatives. Communities with heightened environmental awareness tend to show higher engagement in green programs [22]. Sociologically, enabling conditions, advocacy, and the social environment play critical roles in shaping consumer behaviours, with peer influence being a significant factor [23]. For instance, witnessing positive experiences within one's social circle can mitigate concerns which hinder the acceptance of new technologies [24]. However, the influence of peers, while significant, requires careful evaluation [25]. Social learning, constrained by bounded rationality, leads to a dependency on the path of information consumers rely on for decision-making [26]. In this regard, Hargreaves and Middlemiss (2020) identified three types of social relationships influencing energy use: interactions with family and friends, community and agency connections, and identity relationships [27].

In conclusion, the consumer decision-making process is complex, involving various stages and influenced by multiple factors, with decisions made today affecting future choices. Assessing alternatives can be daunting and stressful, particularly for residential consumers, requiring specialised knowledge to navigate the plethora of available options and significant investments. Moreover, the need for post-purchase adjustments to optimise energy consumption patterns and solutions highlights the negative impacts of operation and maintenance on behaviour change [28, 29]. Risk perception plays a crucial role in decision-making, influenced both by economic factors, like energy costs, and non-economic factors, such as climate change perceptions [30, 31]. Among the several models that attempt to describe the consumer decision-making process, the "five-stage model" provides a detailed framework, encompassing recognition of needs, information search, evaluation of alternatives, purchase decision, and post-purchase evaluation [32–34]. This model offers a linear representation of the decision-making process, enabling the identification of the barriers that have the greatest impact on each stage of the process.

Main Behavioural Barriers to Customer Engagement

In light of the current understanding of energy consumer behaviour, this section proposes a review of the main barriers we encountered in our literature review that can hinder the engagement process in flexibility markets. For clarity, the identified barriers have been clustered into three main groups: (1) lack of awareness, (2) lack of skills to process information and (3) inertia. These three groups of barriers reflect distinct aspects of the engagement process derived from the structure of the previously mentioned "five-stage model": becoming aware of a new issue/opportunity (e.g., the provision of flexibility services), processing the necessary information to make a decision, and a natural aversion to changes that may slow down the engagement process. Our work focuses on the psychological dimension of consumers and allows for the analysis of each barrier group independently from the others. This may be relevant when trying to identify the underlying mechanisms that hinder the engagement process. Despite its relevance, other classifications can obviously be found in the literature [35]. However, a preliminary version of this classification has already been reviewed by several stakeholders in the context of the Horizon Project OneNet [11].

Lack of Awareness

Demand for energy is derived; consumers seek energy not for its direct consumption but as a means to power various devices that enable access to desired services [36]. Energy consumption, while a constant and essential aspect of everyday life, often remains an intangible concept and a minor component of household budgets. This detail is noteworthy, especially since mental accounting − a process where consumers allocate their financial resources into different categories − plays a vital role in their decision-making [37]. Energy typically does not rank high in consumers' priority lists, making it challenging for them to understand how daily activities directly impact their energy consumption. This lack of understanding logically leads to minimal effort in unravelling this complexity [38].

Additionally, daily household tasks require using several appliances (for example, making breakfast involves the use of lighting, refrigerators, microwaves), yet information on the cost of these activities is often not readily available [39]. Many consumers also have insufficient knowledge about the economic implications, whether short-term or long-term, of using certain energy-intensive appliances [40]. Research indicates widespread misconceptions about electricity use and consumption patterns across different populations. An example is the study by White and Sintov (2018), which showed that perceived savings from Time-of-Use (ToU) tariffs had a more substantial impact on their acceptance than actual bill reductions or changes in peak usage during a ToU pilot program [39]. Enhancing consumer understanding of electricity bills, pricing, and expenditures could significantly reduce electricity demand. Nevertheless, existing research has largely overlooked the aspect of consumer awareness regarding their specific consumption patterns and timings, focusing instead on general consumption metrics. This lack of understanding could also pose challenges for

customers as they try to identify which electricity-related activities to shift and when to do so. Understanding time-based energy use may be a prerequisite for adopting technologies that enable the implementation of ToU electricity tariffs [41].

An increase in consumer awareness and interest in energy-related matters correlates with more favourable attitudes towards adopting energy-efficient heating solutions and the willingness to make such changes [29]. For instance, informing consumers has been linked with a higher average willingness to invest in energy-efficient appliances and the installation of thermal insulation at home [42]. Conversely, the absence of online feedback and deficiencies in traditional education methods negatively affect public awareness and trust in energy efficiency information [43]. Interestingly, individuals with limited electricity knowledge are somewhat less inclined towards seeking further information on energy consumption and conservation strategies compared to their more informed counterparts. This reluctance can be attributed to their limited knowledge base, which diminishes their motivation to seek out and assimilate new information. This becomes particularly concerning when considering that higher knowledge levels have been identified as significant predictors of pro-social and environmental behaviours [21].

Lack of Skills to Process Information

While awareness is crucial, it alone is insufficient to enable consumers' decision-making. Consumers also need the tools to process information and make informed decisions. Due to the complex, technical nature of many energy-related decisions, only a minority of well-informed consumers are capable of effectively gathering and analysing the necessary data to make informed choices [28].

Searching for information does not come for free. Information economics theory posits that the effort to acquire information represents a cost, which must be weighed against the potential benefits or utility expected by the consumer as a result of the additional information available to make better decisions. Costs include monetary or opportunity costs associated with the time spent searching but also the mental effort involved in researching, selecting, and integrating new information with what is already known. These perceived costs vary by individual, depending on their research skills, existing knowledge (for example, in the electricity sector), educational background, etc. In extreme cases, consumers may be unable to access or engage with information provided by new technologies, for instance, due to cultural or age-related factors, which can impact the perceived ease of use and usefulness of new devices [44]. Consequently, consumers may make decisions based on incomplete information if acquiring more data is expensive or if they trust their existing knowledge base. However, acting on partial information can lead to decisions that differ from those made with a full understanding of the situation [45].

Moreover, the sheer volume of available information outpaces the ability of humans to effectively process it, forcing them to prioritise some data over others. Consequently, consumers face the challenge of selecting from various information sources. In this regard, some external information channels might serve as substitutes for others or as proxies for the entire body of available information. Limited knowledge of options and uncertainty are significant barriers to engage in electricity markets. For instance, despite decreasing search costs over time, the emergence of complex tariffs has discouraged consumers from switching providers [46]. Similarly, intricate pricing structures can overwhelm consumers, leading to unforeseen decisions [47].

Lastly, perceived scarcity also influences the cognitive process. For example, Suri et al. (2007) noted a paradoxical behaviour where scarcity-induced arousal complicates information processing yet simultaneously increases the effort and motivation to engage with the information [48].

Customer Inertia in Changing Behaviour

Available information is not always utilised. Consumers often disregard information that contradicts their existing beliefs or preferences, exhibiting a preference for information that confirms their ideas (confirmation bias) or is endorsed by their social circles [26]. This leads to a lock-in effect, keeping consumers anchored in their current habits. For those particularly averse to risk, habitual behaviours are perceived as safer due to the presumed certainty of outcomes and probabilities. Generally, there is a noticeable inertia among consumers towards change [49, 50]. For instance, evidence suggests that consumers tend to remain with their current energy providers even when better options exist, a tendency attributed to underestimating potential savings, lack of confidence in new suppliers, complicated switching processes, and loyalty to current providers. Additionally, complex tariff structures further discourage consumers from making changes [6].

Inertia is usually identified with the status-quo bias, although other interpretations can be found in the literature.[2] Samuelson and Zeckenhauser (1988) defined the status-quo bias as the preference for "doing nothing or maintaining one's current or previous decision" [51]. Four main reasons for status-quo bias include transaction costs, decision-making uncertainty, cognitive misperceptions (like loss aversion, or anchoring), and psychological commitments

[2] Regarding the different meanings that the word inertia has assumed in marketing contexts, you may refer to Cui et al. (2021) [49].

influenced by perceived sunk costs or regret avoidance. Broadly speaking, consumers may exhibit a status-quo bias to avoid perceived loses. For instance, Blasch and Daminato (2020) reviewed literature on how loss aversion affects electric appliance adoption [52]. Studies have shown a negative correlation between loss aversion and the efficiency of household appliances, as well as overall energy consumption. Specifically, consumers with higher loss aversion are less likely to invest in energy-efficient home improvements and demand a higher risk premium for such investments.

Moreover, loss aversion is positively associated with distrust, for instance, in institutions or market operators, which can dampen market engagement and amplify inertia. Stenner et al. (2017) demonstrated how trust and distrust serve as heuristics in decision-making, noting that distrust can diminish willingness to participate in direct load control programs [53]. Disengaged consumers are generally less trusting of energy suppliers, and it has been observed that trust in energy companies is lower compared to other sectors, like banking or construction. Additionally, more vulnerable consumers often exhibit lower levels of market engagement and trust, coupled with heightened concerns about increasing costs [54, 55].

Open Issues for Engaging Customers

In developing strategies to address barriers to customer engagement, policymakers and market actors must anticipate potential unintended consequences. Identifying barriers per se is not sufficient to foster engagement. In this section, we explore the main areas of uncertainty in electricity consumer behaviour. Indeed, there is still a lack of extensive literature based on field experiments that can clarify the effect of financial and non-financial incentives and the impact of different strategies in providing information to customers.

As mentioned earlier, study of electricity consumer behaviour is not a new topic per se. A multitude of theoretical contributions have aimed at offering new analytical perspectives, incorporating insights from diverse fields, such as prospect theory applied to energy trading [56–58]. Insights from behavioural economics have also been applied to improve demand response programs [59, 60]. In addition, there exists a body of experimental research, which, however, largely relies on interviews or online surveys rather than direct observational studies of consumer behaviour in natural settings. Despite improvements in the quality of experiments, Buckley (2020) points out that some research lacks methodological soundness, attributed to inadequate control measures, limited sample sizes, brief periods of study, or the issue of self-selection bias [61]. This situation could lead, for instance, to overestimate the effectiveness of incentives designed to encourage electricity conservation. Furthermore, such research might highlight motivations of participants that do not align with actual behaviours observed in real-life contexts. Moreover, some studies may not accurately represent the broader population [62]. This absence of solid empirical data hinders our understanding of how certain intentions, even those declared in surveys, might translate into actual behaviours [63]. The literature describes this phenomenon as the intention-action gap. Gravert (2024) suggests that merely focusing on disseminating information or educating consumers may not be adequate to stimulate activity in the market. The noted gap between intentions and actions can be attributed to individuals who exhibit present bias, procrastinate, and swiftly neglect to make changes [64].

More experimental studies are needed to shed light on the motivations that drive consumers to make decisions in energy-related topics, such as participating in demand response programs. Considering the wide range of options available, tailoring engagement strategies to identify and target groups with shared interests, who are likely to be motivated by similar incentives, could enhance effectiveness [65, 66]. Social factors, too, may offer valuable insights into predicting consumer responses. For instance, findings from Belaïd and Joumni (2020) seem to validate the recognised pattern where the distribution of the potential adoption of energy saving exhibits an inverted U-shape in relation to age [67].

When considering engagement drivers, a fundamental distinction can be made between **financial and non-financial incentives**. Yet, how to effectively combine these approaches to maximise their impact and minimise adverse reactions among consumers remains to be clarified. Current research has yet to definitively prioritise economic over non-economic drivers. However, the mere prospect of monetary savings is inadequate to fully explain, for instance, the decision-making process involved in switching energy providers [68]. Consumers often prioritise benefits that impact their personal health and environmental well-being over financial savings offered by alternative heating solutions [29]. Likewise, economic incentives, like dynamic pricing, may influence behaviour differently based on various non-financial factors [69]. For instance, three kinds of benefits have been identify to better understand why households adopt certain technological solutions: (1) functional benefits – the practical advantages offered by a product or behaviour, (2) self-expressive benefits – what adopting a product or behaviour signifies about an individual, and (3) self-evaluative benefits – how a product or behaviour influences one's self-perception [63]. Research by Mi et al. (2021) indicates that non-monetary interventions tend to be more effective than monetary ones, suggesting that cost-effective, non-financial strategies hold promise for promoting energy conservation

[70]. Moreover, findings by Stedman (2021) suggest that environmental considerations, independence from the grid, and previous technology usage play significant roles in the decision to engage in energy trading, beyond just monetary incentives [71]. Conversely, Azarova et al. (2020) found that the most significant behavioural changes occurred in households receiving financial incentives, albeit with limited evidence of impact within non-monetary control groups. These households initially reduced their energy use in response to financial incentives but subsequently exhibited a rebound effect, leading to an overall increase in electricity consumption [72]. This raises questions about the efficacy of traditional price-based policies in curbing household energy use [73]. A meta-analysis by Khanna et al. (2021) revealed that both monetary and non-monetary interventions can reduce energy consumption in households, but monetary incentives typically have a more noticeable effect on average [74].

Within the spectrum of non-financial incentives, *nudges* have emerged as a noteworthy mechanism to encourage the adoption of pro-environmental behaviours. However, the debate over their true efficacy is ongoing. For instance, research by Buckley and Llerena (2018) illustrates that nudges are on par with price hikes in terms of lowering energy use [75]. Conversely, a study by Bailey et al. (2023) indicates their ineffectiveness in promoting the smart charging of electric vehicles [76]. Moreover, the presence of varying consumer misconceptions can yield inconsistent outcomes on nudge implementation [77]. Consequently, further research should identify strategies that could amplify the impact of nudges, such as those based on the "nudge plus" [78]. Currently, also the literature on the combined impact of price incentives and behavioural nudges is scant, with few studies indicating a positive synergy. The comprehensive understanding of their synergistic effects remains limited, as few studies adopt methodologies that adequately assess synergy, its causes, or mechanisms [79].

Lastly, the approach to **informing consumers** requires careful consideration. Disseminating certain types of information can lead to unintended effects. For instance, if households realise they are spending less than expected, this information might prompt them to increase their consumption [61]. On the other hand, some information might be more impactful when grouped with "complementary" data. For example, Carmichael et al. (2021) suggest viewing smart meters, tariffs, storage, and automation technologies as interconnected could lead to more effective consumer engagement, offering greater benefits to individuals, the environment, and society [80]. But, as previously mentioned, the impact of providing information depends on how consumers process it: in general, higher cognitive skills can make consumer behaviour more rational. In this regard, *boosts* aim to influence behaviour by enhancing competences and correcting biases. However, the effectiveness and context-dependency of boosts are still uncertain. Further research should explore the relationship between the choice of intervention and cognitive aspects [81].

This discussion has showcased various strategies for engaging consumers "actively", through information, feedback, and other means. These strategies may be complemented by "passive" approaches, like default settings. In fact, there is substantial evidence supporting the effectiveness of default options in engaging consumers, such as in adopting new tariffs or green energy sources [82]. Experimental findings by Kaiser et al. (2020) demonstrate the persistence of green defaults, particularly among those concerned with climate change.[3] However, there is limited support for the effectiveness of defaults when consumers are unaware of them, with much evidence suggesting otherwise [83]. Nonetheless, the potential of default options, especially considering their policy implications, warrants further examination, taking into account both monetary and non-monetary factors to assess the likelihood of consumers opting out [84, 85].

Conclusions

Integrating distributed energy sources in the electricity system increased demand for flexibility services, prompting a shift towards establishing dedicated markets where customers can trade "flexibility". Despite the recognised benefits for the electricity system, numerous enabling factors are still lacking to fully deploy the potential derived from flexible consumption.

Understanding consumer behaviour is paramount in formulating effective strategies to enhance customer participation in flexibility markets. Customers' decisions are influenced by various factors, including psychological and sociological elements, and do not necessarily aim to maximise economic benefits. Identifying the primary drivers of customer behaviour and recognising potential barriers are essential steps in this process.

Our literature review has uncovered key behavioural factors that could impede consumer engagement, with a focus on residential consumers. We provided insights into the decision-making process of customers and explored behavioural barriers to engagement, categorising them into lack of awareness, lack of skills to process information, and inertia. The lack of awareness stems from the abstract nature of energy consumption and the limited understanding of its economic impacts. Additionally, customers may lack the skills necessary to process complex information and make well-informed decisions. Finally, customer inertia towards change, driven by factors like loss aversion and confirmation bias, can hinder engagement efforts.

[3] Green default are defined as a pre-selected choice option for "green" (i.e., renewable) versus "grey" (i.e., non-renewable) electricity supply.

Moving forward, it is crucial to acknowledge the complexities inherent in addressing these barriers and to explore innovative approaches that account for the multifaceted nature of consumer behaviour. Efforts should be directed towards understanding and leveraging financial and non-financial motivations to drive customer engagement. Additionally, there is a pressing need to delve deeper into the synergistic effects of price incentives and behavioural nudges, while also carefully assessing the efficacy of various consumer information strategies. Further efforts must be made to fully understand consumer behaviour in order to develop appropriate engagement strategies and avoid outcomes that are contrary to those desired. A major question mark hangs over how much of what we know today about energy consumer behaviour will still be valid in the future decarbonised electricity system. Additionally, it cannot be excluded that customer engagement in flexibility markets will present new elements that cannot be anticipated based on the current knowledge of consumer behaviour. This also raises doubts about identifying the right variables that can determine consumer behaviour. Such insights must, of course, find their place within energy areas that have traditionally followed a purely technical approach but are now compelled to grapple with the substantial influence of consumer behaviour. A multifaceted approach will be instrumental in effectively engaging customers and unlocking the full potential of flexibility markets in the electricity sector.

These considerations are relevant not only for market participants interacting with consumers but also for policy-makers shaping future electricity markets. Effective policies must maximise the benefits of the energy transition while ensuring consumers are aware of new market conditions and can take advantage of the new opportunities.

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Declarations

Competing interests The authors declare no competing interests.

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